SlowStom

Influence de la réponse lente des stomates sur les flux et l'efficience d'utilisation de l'eau des écosystèmes forestier

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Summary —

Context —
Stomatal openings in plant leaves are at the crossroad of carbon and water exchange between plants and the atmosphere. Photosynthesis (A_n) can respond immediately to fast environmental changes while stomatal conductance needs time to adjust. This decoupling of photosynthesis and stomatal conductance (g_s) leads to sub-optimal water-use efficiency and its relevance is unknown on ecosystem level. The dynamic change of stomatal conductance takes between a few minutes to almost an hour, depending on species and variations of atmospherical environmental variables such as irradiance, humidity, CO2. Photosynthesis and stomatal conductance are not fully coupled during this lag time, leading to a suboptimal water use. Decoupled photosynthesis and stomatal conductance is a well-known process in the laboratory, but unknown at the ecosystem scale.

Objectives —
We propose to determine photosynthesis and conductance to water vapour of the whole canopy in one-minute time resolution, taking advantage of new collections of ecosystem data in high temporal resolution as well as methodological advances in processing data from flux towers.

Approaches —
We will apply continuous wavelet transform to estimate ecosystem fluxes with a resolution as high as one minute. We will further take advantage of recent progress in applications of artificial neural networks to estimate photosynthesis from the high-resolution ecosystem fluxes. We will finally be able to study the coupling or decoupling of photosynthesis and stomatal conductance on the scale of the whole ecosystem during different meteorological conditions, with constant or intermittent light.

Expected results and impacts —
Together with the one-minute canopy conductance estimates, this will be the first data set of A_n and g_s on such high temporal resolution on ecosystems scale. This will allow us to study the impact of the An/gs decoupling on the dynamic fluxes on the ecosytem level; and might eventually lead to an inclusion of non-steady state gs in current large-scale land surface models.